1859MNRAS..19..353D

RECENT PUBLICATIONS.

Mr. De la Rue on Celestial Photography.

In the *Photographic Journal* for October 1, 1859, we find the substance of an interesting paper on Celestial Photography, read by Mr. De la Rue at the meeting of the British Association held at Aberdeen in the month of September last. We extract the following passages:—

"The mention of stellar photography—one of the last applications of our art—reminds me that the image of such a heavenly body as a star being of the most simple form, it would render what I shall hereafter have to say more easily understood if I were at once to introduce to your notice what happens in applying photography to sidereal astronomy. The optical image of a fixed star, be it remembered, is an optical point, which, in consequence of the properties of light, is seen in the telescope as a very minute disk surrounded by certain rings, which become fainter and fainter as they enlarge; these rings are always more or less broken up, according to the state of the atmosphere. The photographic image, on the other hand, is a mere speck, difficult to find among other specks present in the most perfect collodion film, when viewed with a high magnifying power.

"Let us now suppose we have a suitable telescope turned upon *α Lyræ*, which is conveniently situated, from its great altitude on the meridian, for photography, and is moreover sufficiently brilliant to give an instantaneous picture. If the telescope be steadily supported at rest, the star will, in consequence of the earth's rotation, course along the field of the telescope in a line parallel to the earth's equator; and as it produces an instantaneous picture, the image obtained is a line indicating the path of the star. We should be led to expect, *à priori*, that the line, for the short distance it is made, would appear straight; but so far from this being the case, the line is much broken up and disturbed, and consists of an immense number of points, crowded in some places and scattered in others. This arises from disturbances in our own atmosphere, which cause the optical image to flit before the eye, which nevertheless can make out the proper figure of the image, although it dances before it several times in a second, and the mind is able to select and remember only the states of most perfect definition. The photographic plate, however, remembers and records all the disturbances, and hence presents, as a result, a number of positions of the point of light, and consequently a less beautiful picture than we see optically.

"In the foregoing remarks it was supposed that the telescope was at rest; but now let us suppose that the telescope is mounted on an axis parallel with the earth's axis, and provided with a driving apparatus, capable of carrying the telescope

1859MNRAS..19..353D

round in the direction of the star's apparent path, so equally that, if viewed by a micrometer eyepiece, the star would remain in contact with one of the wires of the eyepiece. The photographic image of a star obtained by a telescope under these conditions, after some seconds' exposure, is not one clear disk or point, but a conglomeration of points, extending over a greater or less surface, according as the atmosphere produces a greater or less flickering.

"A photographic image of a star, after an exposure of some seconds, is consequently a disk of comparatively large dimensions in comparison with the true image, and can be really seen on the plate. It will readily be seen, that as a single point like a fixed star acquires comparatively large dimensions on a sensitised plate exposed for some seconds to its action, so must every optical point in an image of other celestial objects from the same cause occupy a space of greater or less dimensions; hence the photographic image will never be so perfect as the optical image given by the same telescope until we can produce pictures of all objects instantaneously, and we are a long way from this desirable end at present.

"Notwithstanding, however, the disadvantages under which the photographer labours, I have obtained pictures of celestial objects, showing details which occupy a space less than two seconds in each dimension—I might, I think, say even one second. Now two seconds = $\frac{1}{900}$th of an inch on the collodion plate, and a second on the lunar surface at the moon's mean distance, is about one mile. The lunar picture in the focus of my telescope is about $1\frac{1}{10}$th inch diameter, but this varies, of course, with the distance of our satellite from the earth. It will be conceded that much valuable work has already been done, and that if the photographs are taken for a number of years, selenological disturbances will not escape detection if they take place.

"With regard to the size of focus stated, it might be suggested that it would be better to enlarge the image; but this would prolong the time, and allow greater disturbance to take place. Thus the result would not be so good. It is by magnifying the photographs afterwards that we get good positive copies. One of these on the table is about eight inches diameter; that is to say, it is magnified about seven and a half times.

"Occasionally I take photographs of the fixed stars, and have made pictures of the double star, *Castor*, and others, but, as a general rule, I devote my attention chiefly to the moon.

"As in the production of the lunar pictures some few seconds of exposure are required, it is essential to have a clockwork driver to the telescope, capable of adjustment to lunar time, which differs from sidereal time. In my own telescope this is at present effected by altering the length of the conical pendulum or friction governor, thus altering the time of its rotation (or double beat). And this plan, or some modification

1859MNRAS..19..353D

of it, is universal. My experience, however, has pointed out several inconveniences in thus changing the speed of the governor or pendulum; and it is my intention to make such alterations in the construction of the clock as will enable me to alter the going of the telescope without changing the rate of the pendulum. This I proposed to do by substituting what is known as the disk and plate in mechanics for the wheel-work now immediately connecting the machinery of the clock with the pendulum,—the disk and plate being capable of producing a variable motion according as the disk is nearer to or farther from the centre of the plate. The pendulum will, by the proposed plan, be driven by frictional contact, and having employed this system in other machinery, I feel persuaded that its application to the clock-driver will not be attended with difficulty.

"Until very lately my lunar pictures were obtained by placing the sensitised plate at the side of the tube, opposite the diagonal reflector of my Newtonian telescope, and hence the light before it reached the plate had been twice reflected. I would remark that it requires a very firm support for the diagonal mirror of even a 13-inch mirror; hence the arm carrying this mirror was firmly screwed to the side of the telescope-tube, and being immovable I could not make experiments in taking the pictures direct; that is to say, with the light only once reflected without some contrivance for removing the small mirror. I have within the last few months contrived a proper apparatus, and I now take celestial pictures at will, either direct or reflected, at the side of the tube, and it does not require more than a minute to change the apparatus to produce either result. So that I can make experiments to determine the relative actinic intensity of the light after one or two reflections. The experiments are still in progress, and have been begun so recently that it is scarcely advisable to hazard a conjecture as to the result; but I may say that I am disappointed as to the increased rapidity of the production of a lunar picture by the direct method over the twice reflection method. And I am inclined to infer that Steinheil's result, as to the loss by reflection of the luminous ray, does not hold as regards the actinic ray.

"The reflecting telescope has considerable advantage over the refracting one for celestial photography, on account of all the rays coming to a focus at the same plane, which is not the case with the refractor; hence the focus having been adjusted for the luminous image, it is correct for the chemical image, and has not to be disturbed as with the refractor. I attributed much of my success to the employment of a reflector, while my fellow-labourers in the same field have used refractors.

"The time occupied in taking lunar pictures varies considerably. It depends on the sensitiveness of the collodion, on the altitude of the moon and her phase. I have recently pro-

1859MNRAS..19..353D

duced an instantaneous picture of the full moon, and usually get strong pictures of the full moon in from two to five seconds. Of course it is important to have the collodion in a right state, and to be prepared to operate with clean hands and not with dusty apparatus—the moon as a crescent under like circumstances would require about 20 to 30 seconds, in order to obtain a picture of all the parts visible at the dark limb.

"Portions of the moon equally bright optically, are by no means equally bright chemically; hence the light and shade in the photograph do not correspond with the light and shade in the picture; and therefore the photograph frequently renders visible details which escape optically. Those portions of the moon, near the dark limb, are copied photographically with great difficulty, and it frequently requires an exposure five or six times as long to bring out those portions illumined, by a very oblique ray, as others apparently not more bright when more favourably illuminated. The high ground in the neighbourhood of the southern portion of the moon is more easily copied than the low ground, usually called seas, and I ventured in another place to suggest that the moon may have an atmosphere of great density, but of small extent; and this idea has, I imagine, received some confirmation from a recent observation of Father Secchi's, of the lunar surface polarising light more in the great low-lands, and in the bottoms of the craters, and not appreciably on the summits of the mountain-ridges.

"Photography brings out palpably to our senses several facts, which are of course well known, but we do not always think of them—for example, every 29 days we talk of the full moon. Now there is never a full moon visible except before or just after a lunar eclipse. At all other periods of the full moon we are unfavourably situated for seeing the whole of the illuminated hemisphere. The different apparent diameter of the moon at different times, dependent on her distance from the earth, comes out in unmistakeable prominence. We are familiar with the moon's librations in latitude and longitude, yet we fail to realise the great amount of disturbance unless aided by photography, when we see it palpably before us. Taking advantage of the libration of the moon, we get stereoscopic pictures which present to the eye what the Astronomer-Royal has said was the only experimental proof of the rotundity of our satellite. Mr. Claudet has told us that a dispute has been going on between photographers as to the proper angle for taking photographic pictures, and I infer that one side of the disputants would call my arrangement of the moon-pictures to produce photographs unnatural. But, to use Sir John Herschel's words, the view is such as would be seen by a giant with eyes thousands of miles apart."

Excellent views of *Jupiter* and *Saturn* were exhibited. Amongst the views of *Saturn* exhibited, there was one taken

1859MNRAS..19..353D

at the period of the late occultation of the planet by the moon, and on the photographic plate were delineated the planet and the moon—the former as just emerging from the moon's bright limb. The views of *Jupiter* were sufficiently large to give stereographic pictures. With respect to *Saturn*, the pictures were so small as not to be visible in an ordinary stereoscope; but there was exhibited on the table a stereoscopic view of *Saturn*, composed of two photographic reductions from the original drawings of Mr. De La Rue made with great accuracy in 1854 and 1856 respectively—the body of the planet standing out as a spheroid encircled by its rings.

Mr. De La Rue proceeded to give a description of the work performed at Kew Observatory (under the British Association), where, at the suggestion of Sir John Herschel, a photoheliograph had been erected, under the direction of Mr. De La Rue, at the request of the Royal Society. Many obstacles, which have been overcome only by repeated experiments, stood in the way of obtaining good pictures of the sun; and these difficulties arose in a great measure from the extreme brilliancy of the sun's image. Mr. De La Rue described the photoheliograph as follows:—The instrument consists of a three-inch object-glass (made by the late Mr. Ross), corrected specially to insure coincidence of the chemical and visual ray. The image is not received directly on the sensitive plate, as is the case in taking lunar and planetary photographs, but is enlarged before it reaches the plate, by means of a secondary lens, which magnifies the sun's image to about four inches in diameter. The time of exposure is so short, that there is a necessity for a special contrivance for regulating the time of exposure. This is effected by means of a sliding-plate placed just before the secondary lens. In this plate is a slit which is adjustable in width. The plate before taking the picture is held up by means of a thread. In this position the light is shut off from the sensitive plate. When the picture is about to be taken the retaining thread is set fire to, and a spring pulls the plate rapidly across the secondary lens. The time of exposure depends on the rapidity of passage of the sliding-plate before the secondary lens.

There have been recently some remarkable spots on the sun; and several views of that luminary were exhibited by Mr. De La Rue, which showed the progress of these spots across the sun's disk, and the remarkable changes they had undergone during the intervals. The photographs also rendered evident the *faculæ*, or bright spots on the sun. Taking advantage of the change of position of the sun's spots in the interval of one, two, or three days, Mr. De La Rue had produced some stereoscopic views of the sun, by grouping together two photographs taken at those intervals.

The president of the section, Lord Rosse, added some observations on the method of obtaining lunar photographs. He

1859MNRAS..19..353D

agreed entirely with Mr. De La Rue as to his use of a reflecting telescope; and also felt sure he had hit upon the right method of procedure in many of the very nice contrivances he had described to them.

The Rev. T. Chevallier remarked upon the interesting question of how to get rid of the great inconvenience of excess of light in taking photographs of the sun; and alluded to the experiments of M. Porro to overcome this difficulty by the application of polarised light for the purpose of getting the image.

Astronomical, Magnetical, and Meteorological Observations, made at the Royal Observatory, Greenwich, in the Year 1857. Under the direction of G. B. Airy, Esq., M.A., Astronomer Royal. 4to. London, 1859.

This volume contains the usual meridional observations of the sun, moon, and planets, and the standard stars of the *Nautical Almanac.* The other stars observed are principally,—a list of stars whose right ascensions have been well determined, used in conjunction with the *Nautical Almanac* stars, for determining clock-error; stars remaining from former years, including stars to complete previous catalogues; moon-culminating stars; stars which have been occulted by the moon; stars observed with comets; variable stars discovered by Mr. Hind; stars observed with the zenith sector at the Cape of Good Hope; stars which pass near the north horizon; stars suspected of having, or known to have, large proper motions; stars near the pole, used by Mr. Carrington for determination of azimuthal errors; stars compared with *Sirius;* and, finally, stars observed by Lieut. Tennant in the determination of the latitude of Karachi in connexion with the great Indian Survey.

The volume also contains observations of the moon with the altazimuth; observations with the reflex zenith tube; and observations of occasional phenomena with the north and east equatoreals.